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A Self-Financing Multimodal Public-Private Partnership Approach to Restore Metropolitan Mobility

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Abstract: *The Operate-Design-Build-Operate (ODBO) concept presented in this article involves introducing rush hour tolls prior to infrastructure investment to manage demand, with surplus revenue dedicated for infrastructure expansion. Not only would the existing highway system operate more efficiently, but so would the improved system. This approach provides up-front toll revenue to help pay for expensive urban freeway expansion projects, making them more financially feasible. The approach can facilitate private involvement in the delivery of integrated roadway pricing and transit/HOV systems in metropolitan areas. New public-private partnership approaches are suggested that employ outcome-based contracting systems and financial incentives to maximize public mobility goals. An illustrative application at the region-wide level is discussed.*

Recurring freeway traffic flow breakdowns have become endemic in major metropolitan areas in the U.S. Yet, existing sources of revenue from vehicle taxation are barely sufficient to maintain and operate the existing transportation system. Little or no revenue is available for funding of needed highway and transit investments to improve mobility in growing areas. Tolling and public-private partnerships can make up for the shortfall in revenue. However, due to high costs for urban freeway expansion, full financing of such expansions may not be supportable from toll revenue alone, delaying needed projects for want of public tax support.

The Operate-Design-Build-Operate (ODBO) concept presented in this article involves introducing tolls on *existing* congested freeways, *only during rush hours*, to keep demand surges from oversaturating the facilities. It then allocates the revenues as a "down payment" on costs for investment in the most cost-efficient transportation infrastructure expansion. The approach bears resemblance to the free market model in which prices rise, spurring new private investments in production capacity to increase supply, which then brings prices down. The down payment that would be generated from pricing existing capacity would increase the chances for financial viability of high-cost urban freeway expansion projects.

The ODBO concept provides the needed funding and public-private partnership mechanisms to cost-efficiently reduce freeway congestion with a three pronged strategy. This strategy includes elements to: (a) reduce traffic demand surges that cause breakdowns in traffic flow by *increasing the price* motorists pay for highway travel during congested periods; (b) *increase operational capacity* by managing and operating the system for maximum vehicle throughput (in the near term) and *increase physical capacity* at the most critical bottleneck locations in the longer term; and (c) reduce vehicle traffic demand by investing in strategies that *improve the attractiveness of non solo-driving modes.*

Initially, private partners would be selected under a short-term contract to invest in infrastructure needed to manage traffic, charge peak period tolls on the existing system, and maintain and operate the infrastructure. A private partner's skills would be valuable for deployment of the complex schemes and innovative technologies that would be needed. Although the private partner would set the *real* toll rates to manage demand and ensure that traffic is free-flowing, *all toll revenue would go to the public sector*, and the public agency would reimburse the private partner with a flat fee for each vehicle *served at free flow speeds* during rush hours when tolling is in effect. This approach is termed Concurrent Real And Shadow Tolling (CRAST)(DeCorla-Souza 2005a).

The key to ensuring that the private sector will seek to maximize public goals is to use appropriate measures of performance and have appropriate payment schemes that provide the right incentives to private partners to maximize personal and freight mobility. In Phase 2, the private partner (who could be different from the Phase 1 partner) could be paid on the basis of the number of vehicle occupants, i.e., *person* trips (rather than vehicle trips) carried on the freeway facility during peak periods, monitored using advanced technologies to count vehicle occupants. For example, if a vehicle has four occupants, the private partner would be paid four times the flat fee per person. Photographic systems employing near-infrared cameras have been successfully deployed in the U.K. to count vehicle occupants.

Peak Period Pricing to Manage Surges in Demand

Efficiency of existing, new and expanded highways may be maximized by introducing *peak period tolls* on congested segments, with toll rates set at levels that reduce demand sufficiently to eliminate traffic flow breakdowns caused by oversaturated conditions. Such congestion-based pricing increases vehicle speeds as well as vehicle throughput by eliminating the loss of throughput that occurs under severely congested conditions. Throughput loss under severe congestion can amount to as much as 50 percent of capacity. Once freeway vehicle density (measured in vehicles per mile) exceeds a certain critical value, both vehicle speed and vehicle flow (measured in vehicles per hour) drop precipitously. At these high densities, the freeway is kept in breakdown flow condition much after the peak demand period has ended (Chen and Varaiya 2002). With peak period highway pricing, a variable toll dissuades some motorists from entering freeways at those access points where demand surges may push the freeway over the critical density. This prevents a breakdown of traffic flow in the first instance, and thus maintains a high level of vehicle throughput. Due to the increased throughput on free-flowing freeways, *net traffic diversions may actually occur from parallel arterials to the freeway*, reducing congestion in the entire travel corridor.

The public in Washington, DC is familiar with higher transit fares in rush hours, and has accepted such "congestion pricing" on that mode. However, extending this concept to the highway arena will be more difficult. A major effort will be needed to involve the public in developing the pricing concept in order to gain public acceptance. Motorists being asked to pay tolls in advance of infrastructure expansion might feel that they are paying without getting any "physical" infrastructure improvement in return (as with new toll roads or toll lanes). They may not believe transportation officials who provide analytical forecasts showing that motorists' toll payments would be less than benefits from reduced travel times and vehicle operating costs. To address this concern, motorists could be provided guarantees that they would not be charged if promised congestion relief is not delivered. Additionally, those paying tolls could be allocated credits that could be applied towards future toll charges after infrastructure expansion.

Improved transit and ridesharing services, funded from toll revenue, could provide new travel options for those unable to afford the new rush hour tolls. Low-income commuters who have no reasonable access to transit for their commute trips could be provided with toll discounts.

Increasing Operational and Physical Capacity

The ODBO approach would provide incentives to the private partner to maximize operational capacity by developing more innovative ways to manage traffic and reduce congestion, since the private partner's profits are maximized by maximizing free-flowing traffic conditions *and* vehicle throughput.

High (user-paid) rush hour toll rates on some freeway segments would indicate the urgent need for capacity enhancements at these bottleneck locations and would at the same time provide some of the funding needed for the investment. Private proposals could be solicited to address expansion needs. The preferred proposal, which could be from the Phase 1 partner, could then be carried through the environmental review process with assistance from the winning private partner under a Comprehensive Development Agreement (CDA).

After a Record of Decision (ROD) on the environmental document, the final agreement for expansion work and operation of the facility could be negotiated with the winning private partner, and Phase 2 would begin. The private partner would proceed to finance, design and build the project, and would operate and collect tolls on the facility during the design and construction phase and after the expansion is completed. In order to maximize "per person" fee revenue, the private partner would safeguard against disruption of traffic flow during the construction phase.

Multimodal Strategies to Reduce Demand for Solo-driving

To successfully reduce peak period traffic levels without resorting to exorbitant tolls, it is important that reliable, convenient travel alternatives be available for those who do not wish to pay rush hour tolls. (Economists call such strategies "shifting the traffic demand curve" as against pricing which causes demand to "move up the demand curve"). Alternatives must be in place before rush hour tolls are implemented in Phase 1. Travel time advantages relative to solo driving are critical for success of transit and vanpool services. An extra "*rush hour lane*" could be created in each direction on all freeways by re-striping existing highway pavement to allow shoulder use by transit and authorized vanpools and paratransit vehicles during rush hours. Restricting use of the shoulder lane to authorized vehicles with trained drivers would ensure that safety would not be compromised.

The Phase 1 private partner could make the roadway modifications needed to introduce rush hour lanes. It is important that rush hour lanes and new vanpool/express bus systems be in operation at least three months prior to introduction of rush hour tolls, with free transit and vanpool trial periods to encourage use. This will allow the public to get familiar with the new modal options and allow rush hour tolls to be introduced with fewer concerns from the public about the viability of travel alternatives.

With fee payments to private partners based on *person* throughput rather than vehicle throughput, potential private partners would have an incentive to design their Phase 2 proposals to encourage greater *person* throughput during rush hours by providing incentives for use of transit and ridesharing modes. They might work with other private and public partners to provide vanpool or express bus services and collection and distribution services for express bus trips. They might market travel options to the commuting public. The winning private partner could be selected based on its proposed "per person" fee plus consideration of the amount of new *person trip* capacity that would be provided, as well as other factors such as the proposal's adequacy to serve forecasted travel demand and its degree of financial self-sufficiency, i.e., the extent to which real toll revenue would be adequate to support "per person" fee payments. This would maximize the flexibility of private bidders to come up with innovative, cost-effective and financially viable proposals.

Ameliorating Financial Risks

The ODBO approach reduces forecasting uncertainty. Actual tolled traffic data and toll rates from Phase 1 provide key information about motorists' willingness-to-pay. This reduces the difficulty in forecasting revenue from tolls after infrastructure expansion, and therefore the uncertainty of Phase 2 revenue forecasts. Public agencies would need to be assured that forecasted Phase 2 revenue, along with any dedicated public tax dollars, would have a high probability of covering "per person" fee payments to the private partner. To protect the public agency from excessive financial risk, the agreement with the private partner could set the maximum amount by which total annual "per person" fee payments could exceed annual toll revenue. Once the limit is reached, the private partner could reduce incentives for multioccupant vehicles, thus protecting itself from any reduction in profit. The limit could of course be increased by the public agency if additional public funds were to become available, and if the volume of additional person throughput could justify the additional payments to the private partner.

Unlike conventional public-private partnership arrangements, the public partner would not need to be bound by a "non-compete" clause in the partnership agreement. Such clauses prohibit the public partner from making improvements to alternative toll-free routes. While such improvements to toll-free roads might cause toll rates to drop on the priced facility with consequent reductions in revenue, this should not cause much concern to the private partner, because the private partner's "per person" fee payments would be unaffected. Travel demand in growing metropolitan areas is so heavy that freeways could always be filled to free-flow capacity in rush hours by dropping the real toll rate down to zero if necessary. Thus there would be no effect on total "per person" fee payments to the private partner.

Financial Feasibility of Regionwide Implementation

Potential costs and revenues from regionwide implementation of the ODBO approach were estimated for the Washington, DC metropolitan area, which has about 4 million people and about 300 miles of freeway (about 2,000 lane miles). Phase 1 envisions application of rush hour pricing on all lanes of the entire *existing* freeway system with only minor modifications to provide shoulder rush hour lanes. Private partners would be sought to invest in and operate sub-networks of the freeway system for a period of about 5 years, with options to extend the contract period if necessary. Phase 2 would involve long-term public-private partnerships to provide about 600 new lane miles on the freeway network in an attempt to keep up with future growth in travel demand. Price signals in Phase 1, i.e., high toll revenues relative to costs for infrastructure expansion on some segments, would provide an indicator of the priority that should be given to capacity additions proposed for Phase 2. Private partners could be sought to build, finance and operate the improved facilities for a 30-year period.

Table 1. Annualized Costs and Revenues (2005 $)

	Phase 1		Ph. 2 Transition		Rest of Phase 2	
Highway Analysis	Year 1	Year 5	Year 6	Year 7	Year 8	Year 35
Annualized capital costs for lane additions (million $)	$0.0	$0.0	$437.4	$437.4	$437.4	$437.4
Freeway maintenance costs (million $)	$102.0	$102.0	$102.0	$102.0	$132.0	$132.0
Annualized capital costs for toll coll./traffic mgmt (mil. $)	$6.8	$6.8	$6.8	$6.8	$8.1	$8.1
Operations cost for toll collection/traffic mgmt (mil. $)	$90.1	$101.3	$104.2	$107.1	$99.6	$164.9
Highway cost subtotal (million $)	**$198.9**	**$210.1**	**$650.4**	**$653.3**	**$677.0**	**$742.4**
Contract-period highway costs (billion $)		$1.02				$21.18
Estimated fee rate per peak-period VMT	$0.07	$0.07				
Net revenue after refunding fuel taxes ($million)	**$453.9**	**$557.7**	**$593.0**	**$614.9**	**$420.1**	**$1,129.2**
Contract-period net revenue (billion $)		$2.53				$22.90
Surplus after fee payments (million $)	$255.0	$347.7	-$57.4	-$38.4	-$256.9	$386.8
Contract-period highway surplus (billion $)		$1.51				$1.82
Multimodal Analysis (Hwy, Transit and HOV)						
Annualized express bus service cost (million $)	$159.4	$179.2	$184.3	$189.6	$176.1	$291.8
Annualized cost of parking for transit and HOV (mil. $)	$40.4	$45.5	$46.8	$48.1	$44.7	$74.0
Transit/HOV cost subtotal (million $)	$199.8	$224.7	$231.1	$237.6	$220.8	$365.8
Highway/transit/HOV cost total (million $)	**$398.7**	**$434.7**	**$881.5**	**$890.9**	**$897.9**	**$1,108.2**
Contract-period multimodal costs (billion $)		$2.08				$29.86
Potential transit fare revenue (million $)	$46.56	$52.35	$53.85	$55.37	$51.45	$85.22
Highway/transit/HOV net revenue total (million $)	**$500.49**	**$610.10**	**$646.87**	**$670.27**	**$471.58**	**$1,214.44**
Contract-period multimodal net revenue (billion $)		$2.78				$24.92
Contract-period multimodal surplus (billion $)		**$0.69**				**-$4.94**

Figure 1. Region-wide Highway Costs and Revenues

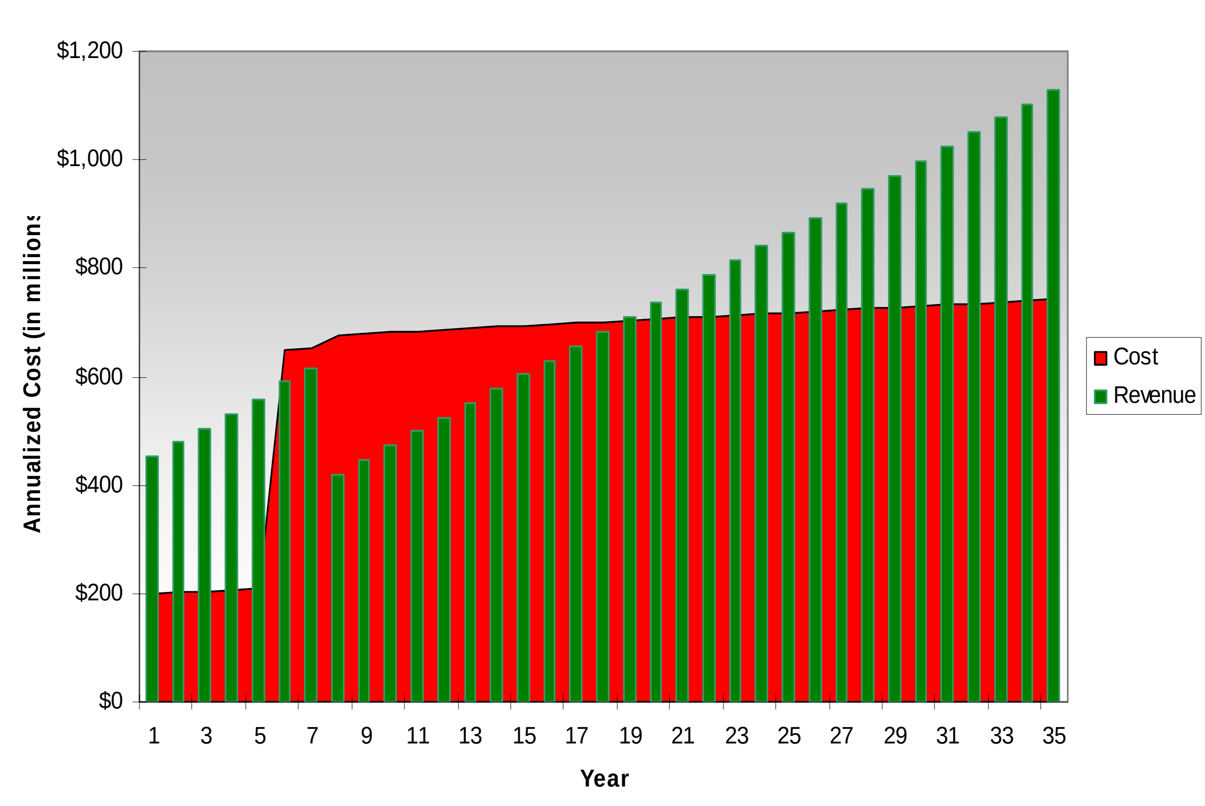
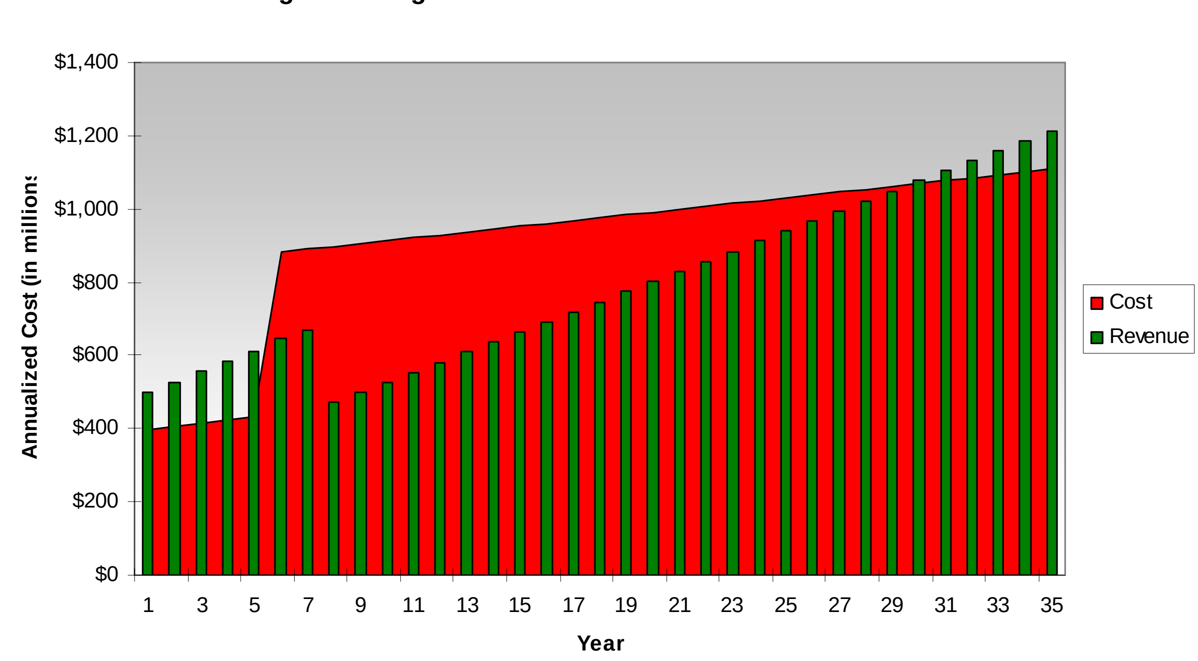


Figure 2. Region-wide Multimodal Costs and Revenues



In order to simplify the analysis, it was assumed that *all* physical improvements will be completed at the end of year 7. Also, all estimates were made in real 2005 dollars. Table 1 presents the results of the analysis. Procedures used to estimate costs and revenue are discussed elsewhere (DeCorla-Souza 2005a and 2005b). The revenue analysis assumes that, in order to address double taxation concerns, it will be necessary to rebate to freeway motorists the amount of fuel taxes paid on fuel consumed by their vehicles during the tolled time periods.

A comparison of net toll revenues to highway-related costs in Table 1 suggests that, for both phases, total toll revenues over the contract periods will be adequate to pay for *highway* costs and there will be significant surpluses. This suggests that self-financing public-private partnership arrangements for highway investment and operation may be feasible for both phases. However, as Figure 1 suggests, there would be revenue shortfalls in the early years of Phase 2, which would be made up by surpluses in later years. This suggests that the shortfalls in the early years could be financed by issuing bonds payable from revenues in later years, or by using credit assistance available under the federal Transportation Infrastructure Finance and Innovation Act (TIFIA).

The multimodal financial analysis is presented in the lower part of Table 1 and in Figure 2. The analysis suggests that net toll and transit fare revenue will be adequate to support the multimodal system in Phase 1. However, in Phase 2, there will be a multimodal budgetary shortfall each year until year 30 (see Figure 2). There will be a significant overall deficit over the Phase 2 contract period (i.e., years 6 through 35). The multimodal deficit gap will need to be covered from public revenue sources, such as the tax resources “freed up” by transferring the responsibility for maintaining and operating the freeway system to the private partner. (Note in Table 1 that freeway maintenance costs, which the public sector would be relieved from, exceed $100 million per year.)

Summary and Conclusions

The Operate-Design-Build-Operate (ODBO) infrastructure-financing approach presented in this paper attempts to eliminate recurring freeway congestion in metropolitan areas by introducing congestion-based tolls *prior* to infrastructure investment with all surplus revenue dedicated for infrastructure expansion. By preventing traffic flow breakdowns caused by recurring congestion, both the existing and future expanded highway systems would operate more efficiently. Up-front toll revenue would help pay for expensive urban freeway expansion projects, making them more financially feasible. New multimodal public-private partnership approaches could employ outcome-based contracting systems and financial incentives to maximize public mobility goals. An illustrative financial feasibility assessment for a regionwide implementation scenario suggests that the ODBO approach would generate net toll revenue (after refunding fuel taxes paid by tolled vehicles) that would be sufficient to pay for all highway capital and operating costs over a 35-year period. Public tax dollars, such as those freed up from prior use for freeway maintenance, would be needed to ensure multimodal financial feasibility.

Disclaimer: The views expressed are those of the author and not necessarily those of the U.S. Department of Transportation or the Federal Highway Administration.

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